[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

[14 CFR part 25]

[Docket No. ; Notice No.]

RIN:

Revised Requirements for Gust and Continuous Turbulence Design Loads

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to revise the continuous turbulence design loads of the Federal Aviation Regulations (FAR) for transport category airplanes by incorporating changes developed in co-operation with the Joint Aviation Authorities (JAA) of Europe and the U.S., Canadian and European aviation industries through the Aviation Rulemaking Advisory Committee (ARAC). This action is necessary because recent measurements of derived gust intensities in actual operation show that the current requirements do not accurately account for the distribution of turbulence in the atmosphere. Also, one of the optional methodologies for treating continuous turbulence (i.e. mission analysis) in the current rule is eliminated since it is overly sensitive to small changes in the definition of aircraft mission. In addition to these issues regarding continuous turbulence, The National Transportation Safety Board (NTSB) has provided a Safety Recommendation, A-93-137 which raises concerns the potential for combined vertical and lateral discrete gusts. This proposal is intended to improve the requirements for continuous turbulence by revising the turbulence intensity criteria, eliminating the mission analysis method, providing a multi-axis discrete gust criterion, and reorganizing and clarifying the rule.

DATES: Comments must be received on or before [insert a date 120 days after the date of publication in the Federal Register]

ADDRESSES: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. . Comments may also be submitted electronically to nprmcmts@mail.hq.faa.gov. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, Airframe and Propulsion Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue, SW., Renton, WA 98055-4056; telephone (206) 227-2131.

SUPPLEMENTARY INFORMATION

Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Persons wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No.   ." The postcard will be date/time stamped and returned to the commenter.

Availability of NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5984).

Internet users may reach the FAA's web page at http://www.faa.govv or the Federal Register's web page at http://www.access.gpo/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, that describes the application procedures.

Background

The manufacturing, marketing and certification of transport airplanes is increasingly an international endeavor. In order for U. S. Manufacturers to export transport airplanes to other countries the airplane must be designed to comply, not only with the U.S. airworthiness requirements for transport airplanes (14 CFR part 25), but also with the airworthiness requirements of the countries to which the airplane is to be exported.

The European countries have developed a common airworthiness code for transport airplanes that is administered by the Joint Aviation Authorities (JAA) of Europe. This code is the result of a European effort to harmonize the various airworthiness codes of the European countries and is called the Joint Aviation Requirements (JAR)-25. It was developed in a format similar to part 25. Many other countries have airworthiness codes that are aligned closely to part 25 or to JAR-25, or they use these codes directly for their own certification purposes. Since 1988, the FAA and JAA have been working toward complete harmonization of JAR-25 and part 25.

The Aviation Rulemaking Advisory Committee (ARAC) was established by the FAA on February 15, 1991, with the purpose of providing information, advice, and recommendations to be considered in rulemaking activities. The FAA and JAA are continuing to work toward the harmonization of JAR-25 and part 25 by assigning ARAC specific tasks.. By notice in the Federal Register (59 FR 30081, June 10, 1994), the FAA assigned several new tasks to an ARAC working group of industry and government structural loads specialists from Europe, the United States, and Canada. Task 2 of this charter concerned the requirement to account for continuous turbulence loads. The assigned task was to review the current requirement for continuous turbulence in part 25 and JAR-25 in light of recent revisions to the discrete gust requirement of Amendment 25-86 (61 FR 5218) in order to determine if the continuous turbulence requirement was still needed and if it was in need of revision to be consistent with the new discrete gust requirement of § 25.341(a). The ARAC Loads and Dynamics Harmonization working group has completed its work for this task and has made recommendations to the FAA by letter dated ______________.

The current requirement to account for the loads produced by continuous turbulence (sometimes referred to as continuous gusts) was proposed by the FAA in Notice 68-18 (33 FR 11913, August 22, 1968). This proposal was the culmination of a research effort by the U.S. aviation industry under a contract by the FAA to develop methods for treating loads resulting from flight in continuous turbulence. The rules in effect at that time required only the consideration of the response of the airplane to discrete gusts. The FAA stated in Notice 68-18 that the discrete gust requirement accounted for the flexibility of the airplane but not necessarily the combination of elastic and rigid body motions. The basic objective of the FAA sponsored research effort was to develop methods of accounting for continuous turbulence loads by considering the statistical nature of turbulence in combination with both the elastic and rigid body modes of the airplane. The results of that effort were published in FAA Technical Reports ADS-53 and ADS-54 in 1966. Subsequently the FAA amended part 25 to require the consideration of loads arising from continuous turbulence (Amendment 25-23, 35 FR 5665, April 8, 1970).

Amendment 25-23 added a new paragraph, § 25.305(d), that required the dynamic response of the airplane to continuous turbulence be taken into account. No methodology or advisory material were provided for showing compliance, however, FAA Reports ADS-53 and ADS-54 suggested two methods in use by aircraft manufacturers. These methods were considered acceptable by FAA. Later, in 1975, the FAA proposed these methods as means of compliance in an Appendix to part 25 (Notice 75-27, 40 FR 24802, March 7, 1975). The FAA subsequently amended part 25 by adding appendix G (Amendment 25-54, 45 FR 60154, September 11, 1980) that set forth the two methodologies (design envelope and mission analysis) and specified the levels of required gust intensities for use in design. Section 25.305(d) was also changed by amendment 25-54 to require that the criteria presented in Appendix G be used unless more rational criteria were shown.

The gust intensities provided for use with the design envelope method have been the subject of contention and debate since the publication of the proposal for Appendix G. Several commenters to that proposal objected to the proposed Appendix G, stating that the atmospheric model was not yet sufficiently defined and that the analyses techniques were still developing. The FAA recognized these shortcomings but, in the interest of safety, decided to go ahead with the requirement with the intention of refining the criteria as more information became available. The requirement provided a sea level value for gust intensity of 85 fps for the design envelope method, however, this could be reduced to 75 fps by using a comparison with a dynamically similar model in which 75 fps is shown to be adequate by service experience. The phrase "dynamically similar model" has been subject to a wide range of interpretations and has resulted in non uniform application of the rule. In addition, the concept of adjusting the gust intensity based on dynamic similarity with another airplane is questionable since the need for a different gust intensity is related more to the intended operation of the airplane, rather than its dynamic characteristics.

The alternative mission analysis method has also been the subject of considerable debate and controversy. With this method, the manufacturer must define a mission for the airplane which includes range, altitude, payload and other operational variables. Then, using a statistical model of the atmosphere, the manufacturer must show that the design strength will not be exceeded, within a certain probability, during the airplane operational life. Predicting the mission is not always reliable since missions can change after the airplane goes into operation. Furthermore, the mission analysis design loads are sensitive to small changes in the definition of the aircraft mission. Therefore, small variations in approach can provide inconsistent results.

Additional shortcomings in the current continuous turbulence requirement have been brought to light by experience in applying the current criteria, experience in service, and by the changing design features of transport airplanes. Many transport airplanes now incorporate automatic flight control systems and other features that can result in significant non-linearity's while the methodology normally employed for continuous turbulence is inherently linear.

Efforts to better define the atmospheric model have continued since the adoption of Appendix G. Recent flight measurement programs conducted by FAA and the National

Aeronautics and Space Administration (NASA) have been aimed at utilizing measurements from the digital flight data recorders (DFDR) to derive gust load design information for airline transport airplanes. The Civil Aviation Authority (CAA) of the United Kingdom has conducted a comprehensive DFDR gust measurement program for transport airplanes in airline service. The program, called CAADRP (Civil Aircraft Airworthiness Data Recording Program), has resulted in an extensive collection of reliable gust data which has provided an improved insight into the distribution of gusts in the atmosphere.

Recently, the regulatory authorities and the aviation industries of the U.S., Canada and Europe have engaged in studies with the aim of finding a single gust design methodology that would account for both discrete gust and continuous turbulence. Although several promising methods are still under study, no single method is considered to be sufficient, at this time, for treating both phenomena. The FAA believes that it is necessary to proceed with the improvement and harmonization of the current gust criteria for both safety and economic reasons. Therefore, ARAC has proceeded with developing harmonized improvements to the continuous turbulence and discrete gust design load conditions as separate requirements.

The FAA recently revised § 25.341 of the part 25 (Amendment 25-86, 61 FR 5218, dated February 9, 1996) to provide a revised discrete gust methodology along with a refined gust distribution model of the atmosphere based on the CAADRP data. These criteria were set forth in paragraph (a) of § 25.341. The continuous turbulence requirement was moved, without change, from § 25.305(d) to § 25.341(b) so that all the gust design criteria, including continuous turbulence, would be specified in the same section of part 25.

ARAC believes, and the FAA agrees, that a continuous turbulence criterion is still needed in addition to the discrete gust criterion since it accounts for the response to totally different, but still realistic, atmospheric characteristics. However, it is recognized that the current turbulence intensity model is inconsistent with the CAADRP data, and with the new atmospheric model prescribed for discrete gusts, and is in need of updating to accommodate modern transport airplanes.

Discussion

The proposed requirement includes a revision to the gust intensity model used in the design envelope method for continuous turbulence, elimination of the mission analysis method, provisions for treating non-linearities, and reorganization and clarification of the requirement.

The FAA proposes to retain the design envelope criterion, but with a revised gust intensity distribution with altitude. The proposed gust intensities are based on analysis of gust measurements from the CAADRP program. The CAADRP data is the most recent gust information available and it represents measurements of gusts and turbulence on transport airplanes in actual operation. In addition, the flight profile alleviation factor already defined for the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996) would be used to adjust the gust intensity distribution according to certain aircraft parameters that relate to the intended use of the airplane. The FAA considers this to be a reliable means of accounting for airplane mission and it would be capable of being applied in a uniform manner.

One member of the ARAC Working Group objected to the definition of a flight profile alleviation factor that changes the design turbulence intensity versus altitude based on selected aircraft design parameters. That member believed that the once in 70,000 hour gust represented an acceptable level of turbulence for design purposes. He accepted that the intensity of the 70,000 hour gust properly varies with altitude; but he believed the probability of encountering a gust of that intensity at any point in time should be constant, regardless of the design parameters of a particular aircraft.

The majority of the ARAC Working Group disagreed. In their view the proposal does not assume that atmospheric turbulence is dependent upon aircraft speed and altitude, or any other aircraft design parameter. The flight profile alleviation factor is simply a mathematical device that allows the expected operation of the airplane to be taken into account by introducing multiplying factors, based on fuel loading and maximum operating altitude, that adjust the required design turbulence intensities. The flight profile alleviation factor in this proposal is identical in magnitude and effect to that used in the discrete gust requirements of § 25.341(a) (as amended by Amendment 25-86, 61 FR 5218, February 9, 1996). To support this proposal, an effort has been undertaken by the industries and airworthiness authorities of the United States, Canada and Europe to evaluate the new proposed criteria and ensure that they are adequate for current conventional transport airplanes as well as for new technology airplanes that may include systems that react in a non-linear manner. Furthermore, the proposed design turbulence intensity distributions are believed to represent the best available measurements of the turbulence environment in which the airplane is likely to be operated.

The mission analysis method for accounting for continuous turbulence loads would be eliminated as an option since the use of this method can provide inconsistent results depending on the assumptions made concerning the potential use of the airplane. The elimination of this method would not be significant since few manufacturers currently use it as the primary means of addressing continuous turbulence. In addition, the mission would be taken into account in the proposed design envelope criterion, since a flight profile alleviation factor is provided as discussed above.

The introduction of advanced flight control systems into transport airplanes has presented special problems in the treatment of continuous turbulence. Some of these systems can exhibit significant non-linearities, while the standard mathematical approaches to continuous turbulence (i.e. frequency domain solutions) are valid only for linear systems. The current rule requires consideration of non-linearities only in relation to stability augmentation systems, however, with modern transport airplanes it is possible that the primary flight control systems and the airplane itself could exhibit significant non-linearities. The proposed rule would require that any significant non-linearity be considered in a realistic or conservative manner, and it would provide additional criteria which can be used with other rational approaches that can account for non-linearities (e.g. time domain solutions).

The elimination of the mission analysis criterion would simplify the presentation of the continuous turbulence requirement so that the requirement can be conveniently presented directly in Subpart C rather than in Appendix G. Appendix G would be eliminated and the continuous turbulence requirement would be set forth, with some reorganization and clarification, in paragraph (b) of § 25.341 "Gust and turbulence loads".

Following an accident in which an airplane shed a large wing mounted nacelle, the National Transportation Safety Board (NTSB) recommended (Safety Recommendation A-93-137, November 15, 1993) that the FAA should amend the design load requirements to consider multiple axis loads encountered during severe turbulence. This recommendation was specifically addressed at gust loads on wing-mounted engines. Although the FAA believes that the existing designs are adequate and that the existing gust criteria have already been improved to the point that they should be adequate for current and future configurations, there remains a possibility that a multi-axis gust encounter could produce higher loads under certain situations. To address the NTSB concern, the FAA contracted an independent organization to develop a method of performing multiaxis discrete gust analysis for wing mounted nacelles. The results of that study were reported to FAA in Stirling Dynamics Labratories Report No SDL –571-TR-2 dated May 1999. The recommendations of that report were accepted by ARAC and the FAA and are set forth in this proposal. The proposal addresses the NTSB recommendation by prescribing two dynamic gust criteria for airplanes with wing mounted engines. These are a round-the-clock discrete gust criterion and a multi-axis dual discrete gust criterion. These criteria are set forth in a new paragraph 25.341(c). The current § 25.445 already requires the effects of combined gust loading to be considered on auxiliary aerodynamic surfaces such as outboard fins and winglets. Furthermore, the current § 25.427(c) requires the effects of combined gust loading to be considered on some empennage arrangements such as T-tails. For airplanes with wing mounted engines, this proposal would extend the round the clock dynamic discrete gust criterion to wing mounted nacelles and provide an additional multi-axis dynamic discrete gust criterion. These criteria, set forth in § 25.341(c), would be applied as airplane dynamic conditions although the assessment would be limited to the engine mounts, pylons and wing supporting structure.

Section 25.571, "Damage tolerance and fatigue evaluation of structure", currently references the entire section 25.341 as one source of residual strength loads for the damage tolerance assessment. No changes are proposed for this reference to § 25.341, so the additional gust loads derived from the new § 25.341(c) would be included in the damage tolerance assessment required by § 25.571.

Some current part 25 airplanes have maximum certified operating altitudes up to 51,000 feet. To be fully applicable to these, and future part 25 airplanes, this proposal defines gust intensities for all altitudes up to 60,000 feet. This is inconsistent with the discrete gust requirements of § 25.341(a) (as amended by Amendment 25-86, 61 FR 5218, February 9, 1996), that define the discrete gust velocities at altitudes up to 50,000 feet only. Therefore, as a conforming change, it is proposed to amend § 25.341(a)(5)(i) to define discrete gust velocities up to 60,000 feet, thereby achieving consistency between discrete gust and continuous turbulence criteria.

With the adoption of the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996), paragraph 25.343 "Design fuel and oil loads" was amended as a conforming change so that the design criterion for the structural reserve fuel condition included only the discrete gust of paragraph 25.341(a) and not the continuous turbulence of 25.341(b). However, the FAA believes that both a continuous turbulence criterion and a discrete gust criterion are needed since they account for the response to totally different, but still realistic, atmospheric characteristics. Therefore, to meet the level of safety intended by the structural reserve fuel requirements it was deemed necessary to include a continuous turbulence loads criterion in paragraph (b)(1)(ii) of § 25.343.

With the adoption of the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996), paragraph 25.345 "High lift devices" was amended as a conforming change so that the design criterion for en-route conditions with flaps deployed included only the discrete gust of paragraph 25.341(a) and not the continuous turbulence of 25.341(b). However, the FAA believes that both a continuous turbulence criterion and a discrete gust criterion are needed since they account for the response to totally different, but still realistic, atmospheric characteristics. Therefore, to meet the level of safety intended by the en-route requirements it was deemed necessary to include a continuous turbulence loads criterion in paragraph (c)(2) of § 25.345.

With the adoption of the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996), paragraph 25.371 "Gyroscopic loads" was amended as a conforming change so that gyroscopic loads were associated only with the discrete gust of paragraph 25.341(a) and not the continuous turbulence of 25.341(b). However, the FAA believes that in order to meet the level of safety intended by the revised continuous turbulence requirements it will be necessary to include gyroscopic effects, where appropriate, in calculation of total loads due to continuous turbulence. To this end a change is proposed to Section 25.371 so that it would reference the entire section 25.341 and include both continuous turbulence loads as well as discrete gust loads.

With the adoption of the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996), paragraph 25.373 "Speed Control Devices" was amended as a conforming change so that the design requirement for these devices referenced only the discrete gust of paragraph 25.341(a) and not the continuous turbulence of 25.341(b). The continuous turbulence paragraph was moved from 25.305(d) to 25.341(b) only as an organizational change, and in order to not impose additional requirements on speed control devices, such as speed brakes, it was necessary to change the reference so that it only referred to 25.341(a). Now, however, FAA believes that encounters with continuous turbulence can result in the activation of speed brakes to slow the airplane to the recommended turbulence penetration speeds, and so the loads induced by turbulence should be considered while these devices are deployed. To this end, a change is proposed to Section 25.373 so that it would reference the entire section 25.341 and include both continuous turbulence loads as well as discrete gust loads.

With the adoption of the discrete gust in § 25.341(a) as amended (Amendment 25-86, 61 FR 5218, February 9, 1996), paragraph 25.391 "Control surface loads: general" was amended as a conforming change so that the design load criterion for control surfaces included only the discrete gust of paragraph 25.341(a) and not the continuous turbulence of 25.341(b). However, the FAA believes that both a continuous turbulence criterion and a discrete gust criterion are needed since they account for the response to totally different, but still realistic, atmospheric characteristics. Therefore, to meet the level of safety intended for the aircraft as a whole it was deemed necessary to design control surfaces for limit loads resulting from the continuous turbulence conditions. To this end a change is proposed to Section 25.391 so that it would include 25.341(a) and 25.341(b) for discrete gust as well as continuous turbulence loads.

The proposal does not include a continuous turbulence design condition at V_B, "the design speed for maximum gust intensity". The design turbulence intensities established for the gust design conditions at V_C, "structural design cruising speed," and V_D, "structural design diving speed," were developed in consideration of the full operational envelope so that a specific continuous turbulence design condition at V_B is not considered necessary, provided the current practices for operating in severe turbulence are continued. Since Amendment 25-86 (61 FR 5221, February 9, 1996) the discrete gust requirements of § 25.341 have not contained a specific discrete gust design condition at V_B. Without any specific discrete gust or continuous turbulence design criteria at V_B there is no technical reason to prescribe a rough air speed based upon V_B. Therefore, it is proposed to amend § 25.1517 to remove the link between V_{RA} and V_B.

Paperwork Reduction

In accordance with the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)), there are no requirements for information collection associated with this proposed rule.

International Compatibility

The FAA reviewed the corresponding International Civil Aviation Organization regulations, where they exist, and has identified no differences in these proposed amendments and the foreign regulations. The FAA has also reviewed the Joint Airworthiness Authorities Regulations and has discussed similarities and differences in these proposed amendments and the foreign regulations.

Regulatory Evaluation Summary

Preliminary Regulatory Evaluation, Initial Regulatory Flexibility Determination, and Trade Impact Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic effect of regulatory changes on small entities. Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these analyses, the FAA has determined that this rule: (1) would generate benefits that justify its costs and is not a "significant regulatory action" as defined in the Executive Order; (2) is not significant as defined in DOT's Regulatory Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would not constitute a barrier to international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

[To be completed]

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionally burdened by Federal regulations. The

RFA requires agencies to determine whether rules would have "a significant economic impact on a substantial number of small entities," and, in cases where they would, to conduct a regulatory flexibility analysis. " FAA Order 2100.1 4A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the affected small entities.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the FAR and the JAR, it would lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined that this proposal does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

Because the proposed changes to the continuous turbulence design load requirement are not expected to result in any substantial economic costs, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 25, 1979). In addition, since there are no small entities affected by this rulemaking, the FAA certifies that the rule, if promulgated, would not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A copy of the regulatory evaluation prepared for this project may be examined in the Rules Docket or obtained from the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR part 25

Air transportation, Aircraft, Aviation safety, Safety.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 of the Federal Aviation Regulations (FAR) as follows:

PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. app. 1347, 1348, 1354(a), 1357 (d)(2), 1372, 1421 through 1430, 1432, 1442, 1443, 1472, 1510, 1522, 1652(e), 1655(c), 1657(f), 49 U.S.C. 106(g)

2. By removing Appendix G to part 25, "Continuous Gust Design Criteria" and marking it "Reserved".

3. To amend Section 25.341 by revising paragraph 25.341(a)(5)(i) to read as follows:

(a) * * * * *

(5) The following reference gust velocities apply:

(i) At airplane speeds between V_B and V_C:

Positive and negative gusts with reference gust velocities of 56.0 ft/sec EAS must be considered at sea level. The reference gust velocity may be reduced linearly from 56·0 ft/sec EAS at sea level to 44.0 ft/sec EAS at 15 000 feet. The reference gust velocity may be further reduced linearly from 44.0 ft/sec EAS at 15 000 feet to 20.86 ft/sec EAS at 60 000 feet.

* * * * *

* * * * *

4. To amend Section 25.341 by revising paragraph 25.341(b) and adding a new paragraph 25.341(c) to read as follows:

(b) *Continuous Turbulence Design Criteria.* The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. The dynamic analysis must take into account unsteady aerodynamic characteristics and all significant structural degrees of freedom including rigid body motions. The limit loads must be determined for all critical altitudes, weights, and weight distributions as specified in § 25.321(b), and all critical speeds within the ranges indicated in paragraph (b)(3).

(1) Except as provided in paragraphs (b)(4) and (b)(5) of this section, the following equation must be used:

$$P_L = P_{L\text{-}1g} \pm U_\sigma \overline{A}$$

Where—

P_L = limit load;

$P_{L\text{-}1g}$ = steady 1-g load for the condition;

$\overline{A}$ = ratio of root-mean-square incremental load for the condition to root-mean-square turbulence velocity; and

U_σ = limit turbulence intensity in true airspeed, specified in paragraph (b)(3) of this section.

(2) Values of $\overline{A}$ must be determined according to the following formula:

$$\overline{A} = \sqrt{\int_0^\infty \left|H(\Omega)\right|^2 \Phi(\Omega)\, d\Omega}$$

Where—

$H(\Omega)$ = the frequency response function, determined by dynamic analysis, that relates the loads in the aircraft structure to the atmospheric turbulence; and

$\Phi(\Omega)$ = normalized power spectral density of atmospheric turbulence given by—

$$\Phi(\Omega) = \frac{L}{\pi} \frac{1 + \frac{8}{3}(1.339L\Omega)^2}{\left[1 + (1.339L\Omega)^2\right]^{11/6}}$$

Where—

Ω = reduced frequency, radians per foot.; and

L = scale of turbulence = 2,500 ft.

(3) The limit turbulence intensities, U_σ, in feet per second true airspeed required for compliance with this paragraph are—

(i) At airplane speeds between V_B and V_C:

$U_\sigma = U_{\sigma ref} F_g$

Where—

$U_{\sigma ref}$ is the reference turbulence intensity that varies linearly with altitude from 90 fps (TAS) at sea level to 79 fps (TAS) at 24000 feet and is then constant at 79 fps (TAS) up to the altitude of 60000 feet.

F_g is the flight profile alleviation factor defined in paragraph (a)(6) of this section;

(ii) At speed V_D: $U\sigma$ is equal to 1/2 the values obtained under subparagraph (3)(i) of this paragraph.

(iii) At speeds between V_C and V_D: $U\sigma$ is equal to a value obtained by linear interpolation.

(iv) At all speeds both positive and negative continuous turbulence must be considered.

(4) When an automatic system affecting the dynamic response of the airplane is included in the analysis, the effects of system non-linearities on loads at the limit load level must be taken into account in a realistic or conservative manner.

(5) If necessary for the assessment of loads on airplanes with significant non-linearities, it must be assumed that the turbulence field has a root-mean-square velocity equal to 40 percent of the U_σ values specified in subparagraph (3). The value of limit load is that load with the same probability of exceedance in the turbulence field as $\bar{A} U_\sigma$ of the same load quantity in a linear approximated model.

(c) *Supplementary gust conditions for wing mounted engines*. For airplanes equipped with wing mounted engines, the engine mounts, pylons, and wing supporting structure must be designed for the maximum response at the nacelle center of gravity derived from the following dynamic gust conditions applied to the airplane:

(1) A discrete gust determined in accordance with 25.341(a) at each angle normal to the flight path, and separately,

(2) A pair of discrete gusts, one vertical and one lateral. The length of each of these gusts must be independently tuned to the maximum response in accordance with 25.341(a). The penetration of the airplane in the combined gust field and the phasing of the vertical and lateral component gusts must be established to develop the maximum response to the gust pair. In the

absence of a more rational analysis, the following formula must be used for each of the maximum engine loads in all six degrees of freedom:

$$P_L = P_{L-1g} + 0.85\sqrt{L_V^2 + L_L^2}$$

Where___

P_L = limit load;

P_{L-1g} = steady 1-g load for the condition;

L_V = Peak incremental response load due to a vertical gust according to § 25.341(a); and

L_L = Peak incremental response load due to a lateral gust according to § 25.341(a).

5. To amend Section 25.343 by revising paragraph 25.343(b)(1)(ii) to read as follows:

(b) * * * * *

(1) * * * * *

(ii) The gust and turbulence conditions of § 25.341, but assuming 85% of the gust velocities prescribed in § 25.341(a)(4) and 85% of the turbulence intensities prescribed in § 25.341(b)(3).

6. To amend Section 25.345 by revising paragraph 25.345(c)(2) to read as follows:

(c) * * * * *

(2) The vertical gust and turbulence conditions prescribed in § 25.341.

7. To amend Section 25.371 to read as follows:

§ 25.371 Gyroscopic loads.

The structure supporting any engine or auxiliary power unit must be designed for the loads, including gyroscopic loads, arising from the conditions specified in §§ 25.331, 25.341, 25.349, 25.351, 25.473, 25.479, and 25.481, with the engine or auxiliary power unit at the maximum rpm appropriate to the condition. For the purposes of compliance with this paragraph, the pitch maneuver in § 25.331(c)(1) must be carried out until the positive limit maneuvering load factor (point A_2 in § 25.333(b)) is reached.

9. To amend Section 25.373 by revising paragraph 25.373(a) to read as follows:

(a) The airplane must be designed for the symmetrical maneuvers and gusts prescribed in §§ 25.333, 25.337, the yawing maneuvers in §25.351, and the vertical and lateral gust and turbulence conditions prescribed in § 25.341(a) and (b) at each setting and the maximum speed associated with that setting; and;

* * * * *

10. To amend Section 25.391 to read as follows:

§ 25.391 Control surface loads: general

The control surfaces must be designed for the limit loads resulting from the flight conditions in §§ 25.331, 25.341(a) and (b), 25.349 and 25.351 and the ground gust conditions in § 25.415, considering the requirements for------

* * * * *

* * * * *

11. To amend Section 25.1517 to read as follows:

§ 25.1517 Rough air speed V_{RA}

(a) At altitudes where V_{MO} is not limited by Mach number, a rough air speed V_{RA}, for use as the recommended turbulence penetration air speed, must be established which:

1) is not less than a speed allowing a positive maneuvering load factor of 1.4 before the onset of perceptible buffeting.

2) is sufficiently less than the maximum operating speed to ensure that likely speed variation during rough air encounters will not cause the overspeed warning to operate too frequently.

In the absence of a rational investigation substantiating the use of other values, V_{RA} must be less than V_{MO}-35 KTAS.

(b) At altitudes where V_{MO} is limited by Mach number, a rough air Mach number M_{RA}, for use as the recommended turbulence penetration Mach number, may be chosen to provide an optimum margin between low and high speed buffet boundaries."

Issued in Washington D.C. on